DOCUMENT RESUME

ED 245 056 UD 023 657

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TITLE "Hi Heels and Walking Shadows": Metaphoric Thinking in Schools.
INSTITUTION Montclair State Coll., Upper Montclair, N.J.
SPONS AGENCY New Jersey State Board of Higher Education, Trenton.
PUB DATE Apr 84
NOTE 20p.; Paper presented at the annual meeting of the American Educational Research Association (New Orleans, Louisiana, April 1984).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Descriptive (141) -- Viewpoints (120)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Class Activities; Cognitive Processes; *Critical Thinking; *Curriculum Development; High Schools; Literature Reviews; *Metaphors; *Skill Development
IDENTIFIERS *Content Area Teaching; New Jersey (Newark); Project THISTLE NJ

ABSTRACT

Although theoretical work has been done on the nature of metaphors, there is little that deals directly with the use of metaphoric language in the teaching of regular school subjects. Yet it is clear that metaphors, and metaphoric thinking, may be used to great advantage in clarifying and elaborating on ideas, and in helping students to develop their critical thinking skills so that they can move from the concrete and the familiar to the abstract and remote. (Metaphoric thinking involves thoughts and ideas, and ways of looking at things, that are formulated and expressed in figurative language.) To foster their 10th-12th grade students' ability to use metaphors, a group of Newark, New Jersey teachers associated with Project THISTLE (Thinking Skills in Teaching and Learning) collaborated on a classroom research project on metaphoric thinking. After various experiments they designed and used a strategy in which students (1) explored the meaning of metaphors in everyday language, (2) analyzed more formal metaphors from their own subject areas, (3) created their own metaphors, first for familiar concepts and then for more abstract concepts, (4) created metaphors for subject-related concepts, and (5) evaluated the final metaphors in general classroom discussions. The experiment made it clear that metaphoric thinking is particularly useful in the development of critical thinking skills. (CMG)

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"Hi Heels and Walking Shadows": Metaphoric Thinking in School

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Paper presented to the
American Educational Research Association
New Orleans, Louisiana

April, 1984

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Project THISTLE is a curriculum and staff development program designed to improve the pre-college preparation of urban students. The support of the Fund for New Jersey, the Victoria Foundation, the Jessie Smith Noyes Foundation, the New Jersey Board of Higher Education and Montclair State College are gratefully acknowledged.

UD023657

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"Hi Heels and Walking Shadows": Metaphoric Thinking in Schools

Project THISTLE: Thinking Skills in Teaching and Learning was developed by Montclair State College faculty in collaboration with the public schools of Newark, New Jersey. It was designed to improve the basic skills of urban college-bound high school students, and thus their chances of success in college, by working with their teachers in an integrated process of curriculum and staff development. Since 1980, more than 100 Newark teachers have participated in Project THISTLE's program of graduate course work in curriculum development and basic skills instruction, supervised classroom implementation, and elective professional development activities.

Project THISTLE, funded in part by the New Jersey Department of Higher Education and several local foundations, cuts across disciplines to focus on thinking as an essential, integral part of both subject area learning and "higher order" basic skills development, particularly reading comprehension, analytic writing, and mathematical reasoning and problem solving. Project THISTLE helps classroom teachers in the various disciplines develop more thoughtful, consistent versions of their own curricular plans, with particular attention to the development of students' thinking skills.

Improvement in thinking skills would, it was expected, be reflected in improved performance on traditional standardized tests of basic skills, as well as in classroom performance. Students of Newark teachers, in grades 10-12, doubled their annual growth rate in reading comprehension, from an average rate of six months in a ten month period to a rate of twelve months, demonstrating the effectiveness of the project (Oxman and Michelli, 1984).

Project THISTLE's curriculum development processes have been, by design, idiosyncratic, as each individual teacher is helped to improve their own curricular plans, using ideas and resources identified in the process of collaboration with college faculty and with their own colleagues. Some of these ideas have been very exciting and fruitful, both in the curriculum development process and in suggesting explorations into the nature of thinking skills themselves, in collaborative research efforts. This paper on metaphoric thinking is among the outcomes of one such effort.

During a class session in one of the curriculum development courses, a high school science teacher, Al Mattia, demonstrated a principle of physics, using standard

laboratory equipment. In response to the questions of his colleagues and teachers, he elaborated on his explanation by using a metaphor. "It's like the difference between walking on snow in low-heeled and high-heeled shoes," he said. The person's weight is the same, but the high heeled shoes exert pressure over a smaller area, and thus make a deeper impression." "Oh!" we said, as we finally grasped the principle he was explaining. Al's metaphor helped us understand by relating something new to something quite familiar.

The understanding of metaphors like these is a fundamental thinking skill involving both linguistic and cognitive comprehension, we realized. Like most thinking skills, metaphoric thinking receives little attention in school materials or instructional processes. Students are rarely helped to develop facility in comprehending and producing metaphors. Direct instruction in metaphoric thinking is almost unheard of in high school subject area classrooms; in fact, there is little reflective thinking of any kind in schools in general (Goodlad, 1983; Oxman and Barell, 1983).

During the summer, 1982, a small group of teachers volunteered to collaborate on a joint research project to develop classroom activities within which to incorporate "metaphoric thinking skills," and to report the results. Al Mattia (Science) Leslie Jenkins (Social Studies), Wanda Davis (Science), Janice Findlay (English), and May Samuels (Mathematics) participated, as did Sarah Sutton (English), who later reported in Project THISTLE's newsletter (1983) that

> The activities used in this investigation provide some useful insights about the need for "metaphoric thinking." Examining ideas and concepts metaphorically stimulates critical thinking, enables one to look at things differently, sheds light on areas that could have remained dark, reveals students' understanding of concepts, adds vividness and color to language, and helps to make ideas more meaningful to students (p. 3).

In a related effort, a different group of Project THISTLE teachers began a systematic search for textbook examples of the use of metaphor, some of which are used herein. This paper is presented in two sections. First, related literature on metaphors and metaphoric thinking in subject area classrooms is reviewed and discussed. In the second section, the processes used in the collaborative research effort on metaphoric thinking in classrooms are described.

Related Research on Metaphor and on Metaphoric Thinking in Subject Area Classrooms

Although direct instruction in comprehending and producing metaphors in subject area classrooms is rare, metaphors themselves are an integral part of our linguistic heritage and are often used implicitly in instructional communication (Honeck and Hoffman, 1980). Examples used in this section have been drawn from school materials in common, current use.

The nature of metaphor. The word metaphor, used in a generic sense, refers to figurative language, including figures of speech, personification, hyperbole, puns, slang, and other forms of non-literal images. Closely related to metaphors are models and analogies. In many ways, the purpose of these forms of communication and the strategies by which they are comprehended involve the same cognitive processes (Rumelhart and Norman, 1981;Davidson, 1976).

(1) Every cell in your body is a small power plant (Otto et al., 1980)

(2) The dinner was a culinary orgy (CEEB, 1982, p. 35)

The examples of metaphor shown above, drawn from a high school textbook and a sample Scholastic Aptitude Test, are understandable only by analyzing the elements of two domains of knowledge in terms of similarities and differences, and synthesizing those elements that are relevant to both domains into a new conceptualization. In this way, the meaningfulness of knowledge in both domains is clarified, enriched, and strengthened. Complex thinking is required to create meaning from the metaphor.

In the successful use of a metaphor, a set of ideas from one domain is understood in terms of a set of ideas from another domain. The word metaphor itself conveys the idea of its origin, as it is derived from "meta," meaning "trans," and "pherein," meaning "to carry" (Ortony, 1975). Metaphor, then involves the carrying over, or transferring, of meaning from one knowledge domain to another, comparatively, from a more familiar area of knowledge to a less familiar one, or interactively, from each area to the other. In order to understand a metaphor, then, one must work toward a comparison which yields both similarities and difference, an analytic higher order thinking skill which deals with what Black (1975) refers to as the "associated implications" of the comparison.

Typically, a word or phrase which is commonplace or otherwise well understood is used metaphorically as a

vehicle to help in the understanding of something less well known or familiar, called the topic, or the tenor, of the metaphor.

(3) An (algebraic) formula is a sort of recipe for doing a certain kind of calculation. (Keedy and Bittinger, 1976, p. 104).

(4) An equation is like a balanced scale. (Denholm et al., 1977, p. 17).

In presenting these metaphors in students' textbooks, the authors are assuming that the students understand the nature and function of recipes and scales--the vehicles of these metaphors, and that this knowledge is likely to be helpful in helping new algebra students understand the nature and function of formulae and equations--the topics of the metaphors. Vehicle and topic are never identical; those identities or similarities which underly both topic and vehicle, and which form the basis for understanding the metaphor are refered to the ground of the metaphor; those aspects of the two areas of knowledge which are dissimilar are called the tension of the metaphor.

Following Ortony (1975), no distinction is made between metaphor and simile; similes may be regarded as metaphor in which the ground--the basis for similarity between topic and vehicle--has been somewhat clarified through the use of "like" or "as."

Metaphors can sometimes be so well integrated into our everyday--and even professional--use of language that we are unaware of their figurative origins. These "dead," or "frozen" metaphors, such as "pitfall," "lukewarm" (used to refer to a level of enthusiasm," "fly-by-night," "dog-eared," "backlog," may be understood either literally or metaphorically, depending upon one's prior knowledge and experience with the terms; that is, depending on whether the metaphor is "alive" or "dead" for a particular individual. These particular metaphors, it should be noted, are considered so important a part of our language heritage that they all appear in Scholastic Aptitude Test sample items; similar ones appear on the tests themselves.

Metaphoric comprehension. Understanding a live, or active metaphor involves intellectual transformations and constructions in an effort after meaning, and includes the stages of error, in which literal interpretations are attempted, puzzlement, and resolution (Pollio et al., 1970). Alternatively, the stages of anomoly, thought experiment, and correction, with iterations are involved (Petrie, 1979). Sticht (1979) notes that these stages of metaphoric comprehension conform to the basic process of inquiry, or

problem solving. The work of metaphoric comprehension procedes until the relevant associations between vehicle and topic are identified, and the ground and the tension of the metaphor are distinguished.

By nature, metaphors introduce novelty, uncertainty, complexity and ambiguity, all elements of paradox and surprise that create cognitive dissonance. Metaphors, then, may be intrinsically motivating (Berlyne, 1965), eliciting the "epistemic curiosity" and analytic thought necessary to solve the problem of comprehension. Sticht (1979) argues "by analogy, that just as the repeated use of a hammer may strengthen the arm, the repeated use of metaphors may strengthen the power of analysis and synthesis (p. 485).

The process of comprehending a metaphor typically involves the construction of a mental image; an image that is built of elements from the vehicle, the more familiar knowledge domain under consideration, and gradually refined to eliminate non-relevant elements. This mental image, which is often visual, is called an "experience-like representation" (Ortony, 1975). Metaphor, he notes, lies much closed to perceived experience than a non-metaphoric equivalent" (p. 48); a vivid image transferred via metaphor communicates in a single "chunk" a wealth of information rich in detail and personal experience, perhaps with emotional associations as well. The vividness of the metaphor, and its closeness to meaningful personal experience, according to Ortony, accounts for its memorability and usefulness in learning. The textbook explanation presented in (5) and (6) demonstrate these vivid representations.

(5) Genetic reassignment is like shuffling a deck of cards.

(6) The "infant industries" were like small children competing with grown men.

Through metaphor, various frames of reference and points of view (themselves metaphors for "multiple perspectives") can be made explicit and considered in the course of educational discussion. Learning to relate things in a variety of ways is a fundamental cognitive skill, emphasized by Piaget (1975) in terms of formal operations and by Cole *et al.* (1971) and Scribner (1975) with regard to distinctions between schooled and unschooled people from pre-literate cultures. Such varied frames of reference may result from the metaphor creator's ability, more evident in formal operations, to "entertain multiple attributes" (Galda, 1981) That is, to play with a number of possible variables, ideas or aspects of topic and vehicle.

For many students, the use of metaphor helps in overcoming a reluctance to consider hypothetical or imaginary circumstances--what Green (1979) call a "kind of incapacity to entertain counterfactual conditionals" (p. 471) such as that posed in questions like "What if Columbus had not discovered America?" at least in educational contexts. This incapacity may be due to overlearning of the bias toward literalness and explicitness in written texts and, according to Olson (1977), in school language generally.

Metaphor and teaching. How are metaphors used in education to motivate thinking, to achieve depth of understanding, to facilitate transfer of meaning, to relate school knowledge to personal experience? Metaphors have, throughout history, been used as tools of communication which were intended to function as explicit pedagogical devices. The 23rd Psalm (The Lord is my Shepherd) and the cave images of Plato are examples of these.

Black (1975) emphasizes the "tight connections" between metaphors and models, and notes that "every metaphor may be said to indicate an analogy or structural correspondence (p. 31). Thus, there is a parallel between the understanding of literary metaphors as figurative language in the study of literature, and models or analogies, as in the "model" of the atom as a miniature solar system in science, or the "model" of fractional parts as pieces of a pie, or the "model" of electrical current as a liquid flow.

The use of metaphor in such passages as

(7) Josephine strutted into the room in full plumage.

would be unsurprising as a literature selection in reading material for children; teacher guidance in understanding of the meaning of passages like this would clearly be helpful in later success on tasks such as the analogy item from a sample Scholastic Aptitude Test in example (8)

(8) Apparel:person::

(1) prey: animal
(2) camel: water
(3) plumage: bird
(4) cat: tree
(5) horse: racetrack

(CEEB,1983, p. 35)

Guidance and practice in analyzing the figurative references in science or social studies texts, such as

(9) No one gland or organ serves as the one controller of the body. The nervous and endocrine systems harmonize all the other systems, but the music would lack its full effect without the whole orchestra playing. (Rosenberg et al, 1978, p. 116).

surely leads to increased ability to comprehend the passage from a Scholastic Aptitude Test selection such as

(10) The first human being to emerge from the earth's atmospheric envelope, in the 1960's, were able to do so because they packaged that atmosphere in their amniotic spacesuits and spaceships. (CEEB, 1982, p. 32)

The use of metaphor, then, is a "key pedagogical tool" (Petrie, 1979, p. 460). Metaphors can have great heuristic value in the teaching of new concepts, in providing experience in the processes of analytic thinking and problem solving, in bridging the gap between old and new knowledge, and in making school learning meaningful in the context of lived experience. In addition, they may be useful for teaching alternative conceptualizations (Rumelhart and Norman, 1981).

There are, however, arguments against the use of metaphor in teaching. These arguments reflect attitudes suggesting that, at best, metaphors have only decorative or ornamental value, but are "frills," irrelevant to the educational process; or, at worst, metaphors are misleading and confusing, and thus harmful to immature minds (Pollio et al, 1977). Pedagogical texts, and teachers' guides to student texts typically reflect these attitudes and make few, if any, suggestions for using metaphor effectively in teaching. Current pedagogical knowledge regarding metaphor includes the ideas that

1. Teachers should avoid metaphor because

a. children have enough difficulty distinguishing between truth and falsehood as it is, and would be confused by the introduction of partial truth, particularly by the teacher in authority.

b. implied similarities can too easily be confused with literal reality (Emig, 1972).

c. metaphors may indeed be compelling and memorable, but so are advertising and political slogans; they must be avoided as misleading.

d. metaphor calls attention to language itself, diverting attention from the real content of instruction, and is thus distracting.

e. metaphor is a waste of time. The facts are known and there is so much real content to cover.

2. Some educators, who feel that metaphors have some aesthetic value, believe that

a. children can be assigned tasks involving the composing of figures of speech in order to appreciate their difficulty and the amount of work required to produce them (Pollio et al., 1977).

b. metaphor can be used by students to add interest and beauty to their creative writing.

c. metaphor belongs to the high school English curriculum in which students learn the difference between metaphors and similes in poetry.

Despite these cautions and delimitations, however, metaphoric language "abounds" throughout children's literature, textbooks and other educational materials.

Pollio et al. (1977) provide a literature review of a series of studies of children's language arts textbooks, texts for teachers, and educational materials in reading and writing, noting that "metaphor, when treated at all, was still taught largely as a neglected stepchild of a slightly less neglected parent, poetry" (p. 196), in "marked contrast to the actual occurence of figurative expression in children's reading materials" (p. 198). This occurence is "extraordinarily high, considering that little direct instruction was given to help the child in learning how to use or interpret such usage." Pollio concluded that " children apparently are supposed to produce, comprehend, and interpret figurative language without any direct teaching in the mastery of such usage. Research studies have shown that children do indeed have difficulty with metaphoric, non-literal language, and need and can profit from such direct instruction (p. 208).

Collaborative Research on Metaphoric Production

In this section, the processes used in the collaborative research project on metaphoric thinking conducted within Project THISTLE are described. Sutton (1983) reported:

> Several teachers participating in project THISTLE embarked upon a project to challenge their students to create metaphors for fundamental ideas, concepts or principles within their subjects. Once created, students were asked to explain their reasons for the kinds of relationships presented above.
>
> To begin our project, a series of activities was designed to make the students aware of what a metaphor is through the analysis of some common, everyday metaphors such as "she's a real dog," "life is a bowl of cherries," etc. Then we analyzed a metaphor from Macbeth: "Life is but a walking shadow." Next, students began warm-up activities -a kind of 'play' with metaphors - by creating their own metaphors for familiar concepts such as "school is...," "writing is..." We continued these warm-up activities with creative compositions such as "what plant/animal are you like and why?"
>
> These warm-up activities stimulated imaginative and critical thinking in students because they had to analyze the qualities of the concepts and find similar qualities in concepts that were entirely different. At this point students were able to create metaphors for more abstract concepts such as "thinking is...," "courage is...," "love is..."
>
> The warm-up activities gave students the opportunity to get involved in the critical thinking processes necessary to understand and use metaphors. To explore further the effects of "metaphoric thinking," the next activities involved applying metaphoric thoughts to subject-related concepts. In creating metaphors for subject-related concepts, students first had to identify the qualities inherent in the concept and then discern those qualities in another domain. They had to involve themselves in critical analysis and imaginative thinking that helped them relate new concepts to their prior knowledge. This relationship between the very familiar and the slightly strange makes key ideas such as imperialism, factorization, and mitosis more meaningful."

Our purpose, indeed, was to find ways for students to make curricular concepts more meaningful and memorable by providing direct instruction in metaphoric production. We focused on helping students to create metaphors and then to

explore the meanings of the "associated implications" relating to topic and vehicle. Thus, we worked on fostering students' ability to understand important curricular concepts and to make them more meaningful through metaphoric production and the complex, often abstract thinking processes associated with such production.

The teachers, seven in all, represented every major subject area in secondary school, language arts, social studies, mathematics, and science. They worked with students in grades 10 - 12 in two Newark high schools. The motivation to participate in this pilot project stemmed from several sources; their interest in challenging their students to engage in reflective thinking in a novel fashion; their desire to study the research literature in their own subject areas; and their desire to participate with colleagues in a new adventure that was part of a group effort. From the outset, there were two major objectives for teachers: to learn about metaphors and to learn to use metaphoric comprehension and production as a way to enhance their instructional programs.

Learning about metaphors. One of the co-authors of this paper and the seven teachers met after school to begin learning more about metaphors. We read articles by Ortony ("Why metaphors are necessary and not just nice," 1975) and excerpts from Black's *Models and Metaphors* (1962) and Bronowski's *The Identity of Man* (1971) and *Science and Human Values* (1956). Using these resources we examined such metaphors as "Life's but a walking shadow..." to determine how it might be a substitution, comparison, or interaction (Black) between the principal and subsidiary subject.

We explored the "associated implications" of "Life" and "walking shadow" to see if or how "the metaphor selects, emphasizes, suppresses, and organizes features of the principal subject (the topic) by implying statements about it that normally apply to the subsidiary subject (the vehicle)" (Black, 1962, p. 44). We were investigating the metaphor as systems of related meanings, thus becoming more familiar with how students might indeed expand their own sphere of meanings by creating them. Holding to the proposition that meaning refers to a system of "referential associations" (Johnson, 1975), and that increased meaningfulness results from extending one's network of such associations, we found support for the notion that students would benefit from metaphor creation. "Learning may be said to be meaningful to the extent that the new learning task can be related to the existing cognitive structure of the learner, i.e., to the residual of his earlier learnings" (Johnson, p. 427). Challenging students to create relationships between major curricular concepts and their own "earlier learnings" would seem, therefore, to be very

beneficial.

We also investigated Bronowski's work on metaphors and models as well as his view of the imaginations as that which opens the system so that it shows new connections (1978). From there it was a short leap to the view of Black and others that metaphors and models can be creative: "a metaphoric statement can sometimes generate new knowledge and insight by changing relationships between the things designated"(1979, p.37).

Thus, we learned about metaphor's interactive and creative nature preparatory to challenging students to think of their own metaphors for subject area concepts.

Designing a strategy. Next, it was important to design a way of working with students so that they understood what they were being asked to do and could fulfill the task successfully. During the course of several weeks we experimented with various kinds of learning experiences and settled upon the following:

1. Exploring the meaning of metaphors in everyday language (e.g. He's cool; that's a turn on)

2. Analysis of more formal metaphors from their own subject areas (e.g. Life's but a walking shadow, Ghandi looked in the face of a two thousand year old despair and stared it down)

3. Warm-up activities: creating metaphors for concepts such as school, writing, being a student, Monday mornings, etc.; creating metaphors for the self based on plants or animals (What plant or animal are you like and why?); and creating metaphors for more abstract concepts such as love, duty, courage, and thinking.

The warm-up activities gave teachers the opportunity to set the stage for asking students to create metaphors for significant ideas and concepts within their subject areas. For this final process, we devised an approach that was somewhat elaborate:

1. Identify a major concept.
2. Analyze its significant aspects, elements, etc.
3. Find a referent within your own experience with similar characteristics.
4. Match the topic and vehicle in a metaphor.
5. Evaluate the quality of the metaphor; that is, the degree to which there is appropriate "ground" and "tension" underlying the metaphor.

This process was based upon an earlier suggestion (Barell, 1980) that metaphor making might be more advantageous for students than constantly memorizing only those that others have created. In actual practice, many students were able to carry out these processes in their heads without having to write them out. This ability, of course, is a function of when during the instructinal process they were creating the metaphors, at the beginning, middle, or end. Our students were fashioning metaphors after studying them rather extensively.

Some results and observations. Teachers made a number of valuable observations during the "warm-up" process. "I observed that students who had demonstrated formal operational abilities ... had less difficulty in attempting to interpret such metaphors as 'Life's but a walking shadow.' Some students," noted Sarah Sutton, "were able to associate 'shallow' and 'without substance' to shadows and Macbeth's life, whereas more 'concrete' students could not readily make these kinds of associations" (Sutton, 1982). The educational benefit for these students derived from the ensuing discussion. As Sutton noted, "their eyes were opened by their peers to a different way of looking at things." And these kinds of experiences are the complex challenges that nurture more abstract thinking.

Leslie Jenkins, a history teacher, noted that at first, students gave definitions, rather than metaphors, such as "School is ... a place to get an education." To stretch their thinking about school, she challenged them to "think of things in nature, religion, entertainment, construction, or plant and animal life" (Jenkins, 1982). Jenkins also noted that this kind of imaginative challenge placed students and teachers in a relationship different from the one of "institutionalized dominance and subordination" that too often predominates. She struggled with giving students "room for the exercise of initiative." "It is hard," she continued, "for a teacher to drop the habit of looking over the students' shoulders." As in all experiences that challenge students to go beyond the obvious, or to transcend the system to reveal new connections, the adult loses a degree of control; students themselves forge the linkages that make the concepts meaningful to them.

Another observation is important. Once the metaphoric statements had been completed within the classroom activities, each teacher conducted a general discussion that evaluated the "fit" of the metaphor. It was during these discussions that students learned from their peers, were able to point out strengths and weaknesses of various metaphors, and quite often, new metaphors were generated out of the discussion. As Johnson and Johnson (1979) noted, creative production is fostered by this kind of diversity of input within a collaborative, trusting setting.

One final note on the evaluative process. It was during this phase that Leslie conducted a debriefing with one student who said, "Democracy is a parking lot." While analyzing the systems of associations point by point, he commented, "You know, I've never thought so much about my own thinking before." This metacognitive, reflective statement may be one of the most important unintended outcomes of metaphoric creation.

Student productions. Many of the students' metaphoric statements reveal their cognitive abilities as well as their understanding of the concepts presented to them by the teachers. These were the concepts teachers selected: Theme (language arts); Imperialism, Colonialism (social studies) and Factorization (mathematics).

> Theme is getting to the middle of an artichoke. You get to the middle and you see what made all the leaves. That is the root of it. (LaTanya)

> Theme is a pomegranate. Every little seed of the pomegranate is a part of it just as every element of a story is a part of the theme. (Robert)

> Imperialism is like a shark. A shark seems to own or have power over less powerful fish...Colonialism is a pimp who takes all the money..Autocracy is a game of "Simon says"...Factorization is like slicing a cake and eating it piece by piece.

Observations and insights. Many useful insights were gained by teachers participating in this experience, including

1. Comprehension of metaphor is a function of cognitive development. Teachers were able to discern differences between more concrete and abstract thinkers in their analysis of metaphors presented to them and those created by their peers. Students who created definitions rather than metaphors for key subject area concepts may be more concrete than a student like LaTanya who wrote that "theme is getting to the middle of an artichoke."

2. The process of creating metaphors is a viable means of developing and assessing students' understanding of concepts critical to any subject area. Furthermore, the mental processes required to make such a metaphoric statement as the one about artichokes requires analysis, synthesis, and evaluation on the student's part and is, therefore, a very complex mental operation.

3. Metaphors created during "warm-up" activities with "school" as the "topic" often revealed elements of the "hidden curriculum" with students comparing schools to prisons, for instance. Teachers challenged students to be more positive, but what their initial reactions revealed disclosed was a rather thorough negativism. One student in May Samuel's class noted, "Being a student in this class is like living in the jungle and being the only zebra." Her feelings of alienation was a surprise to the teacher.

4. Teachers' library research on metaphoric thinking in their subject area fields revealed very little, if any, examples of the kind of learning experiences they were presenting to these Newark high school students. Some research had been done on students' abilities to comprehend metaphors presented to them. As noted above, we discovered students' difficulties with such abstract metaphors as "life's but a walking shadow..." Our students with more formal thinking abilities had less difficulty, not surprisingly, than those who were more concrete. If, as Galda (1981) asserts, understanding metaphors "requires the ability to entertain multiple attributes," it would seem logical that participating in classroom experiences in interpreting and creating metaphors might foster the kind of complex abstract thinking described by Piaget as developing during adolescence.

5. Finally, it seems necessary not only to interpret and create, but to engage in critical evaluation of one's own and others' thinking. Leslie Jenkins presented her students with the conventional Melting Pot theory of American assimilationism. She required her students not only to understand but to challenge it. Students were asked to evaluate its applicability and appropriateness for what occurs in our society. Similarly, we should afford students opportunities to examine critically other metaphors and models encountered in subject area content; e.g. the "domino theory," etc.

Several members of the group of participating teachers completed their work by presenting an in-service workshop for more than 100 of their colleagues on the metaphoric thinking project, under the direction of their college instructor. The workshop was so well received that further work on metaphoric thinking within Project THISTLE has been planned.

Summary and Epilogue

Metaphoric thinking involves thoughts and ideas and ways of looking at things that are formulated and expressed in figurative language. Although there is theoretical work that has been done on the nature of metaphore (see, for

instance Ortony, 1979; Honeck and Hoffman, 1980), and the understanding and use of figurative language is taught as part of English literature and creative writing, there is little in the research literature in the field of education that deals directly with the use of metaphoric language in the teaching of regular school subjects. There are a great many books on curriculum and methods of teaching that do not mention it at all, and yet it is clear that it may be used to great advantage in clarifying and elaborating on ideas, in helping students move from the concrete and familiar to the abstract and remote; from the known to the unknown.

Metaphoric production involves both creative and critical thinking; creativity to dream up metaphors like the ones produced by our Newark high school students: "research is a hiking trip," "an outline is a road map;" and critical evaluation to judge the extent to which the metaphor is appropriate or misleading ("democracy is a parking lot;" "footnotes are like feet").

Students of our Newark teachers involved in this project found the instruction valuable, according to their teachers, as they often used metaphor spontaneously in later classroom activities. One student, frustrated with the inattention of others to an assigned group task commented "Working with this group is like trying to gather blowing leaves." Another student asked a teacher in the course of an unrelated discussion "May I answer that question metaphorically?"

We embarked upon this project in order to assist students in extending the meaningfulness of curricular concepts by engaging in creative and critical thinking. Hannah Arendt (1977) noted that "analogies, metaphors and emblems are the threads by which the mind holds onto the world...moreover, in the thinking process they serve as models to give us our bearings..." This kind of activity is natural for all of us. In schools, however, there is typically no time spent creating and critiquing those models and metaphors that help us to interpret our experience. Throughout the course of this project, it has become clear that interpreting and creating metaphors for key curricular concepts in subject area fields is a particularly useful classroom activity in helping students seek out and create meaning from experience; that is, in helping students improve their "thinking skills."

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